

# Condensers and Cooling Towers

## CHAPTER I Condensers

**General.**—A condenser consists of a closed vessel of suitable form into which the exhaust steam from an engine is led and there condensed. The pressure of the steam entering the condenser depends primarily upon the temperature at which the steam condenses: the lower the temperature the lower is the pressure, as is seen by referring to the relation between the temperature and pressure of saturated steam given in the steam tables, Vol. IV, p. 225. To condense the steam the latent heat in the steam has to be absorbed by some cooling agent, usually cooling water supplied in sufficient quantity to take up the heat liberated, and the temperature at which condensation takes place is therefore largely dependent upon the temperature of this cooling water. For example, if the steam entering the condenser condenses at 110° F., a reference to steam tables shows that the pressure of the steam is 1.27 lb. per square inch absolute, or  $(14.7 - 1.27) = 13.43$  lb. per square inch below the normal pressure of the atmosphere. In this case the "vacuum" in the condenser would be  $-5^- = 27.4$  in. of mercury.

Therefore the back pressure on the engine piston would be correspondingly low during the exhaust stroke. When an engine exhausts to the atmosphere, however, the back pressure is slightly above atmospheric. It may be stated, therefore, that the main purpose of the condenser is to increase the amount of available work at the engine cylinder per pound of steam used compared with that obtainable with a non-condensing engine. In reciprocating steam-engine practice, however, it is generally considered that no appreciable increase in all-round economy results with condenser vacua higher than about 26 in. (barometer 30 in.). The main reason for this limit of economical vacuum is the inability of the reciprocating engine to expand

the steam  
economically right down to the back pressure, the pressure  
at the point of  
exhaust in the low-pressure cylinder usually being several  
pounds per square  
inch above the back pressure,